MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

EMT2036 – ENGINEERING MATHEMATICS 3

(All Sections / Groups)

15 OCTOBER 2018

2.30 PM – 4.30 PM

(2 Hours)

INSTRUCTIONS TO STUDENTS:

1. This exam paper consists of **4 pages** (including cover page) with **4** Questions only.
2. Attempt **all** 4 questions. All questions carry equal marks and the distribution of marks for each question is given.
3. Please print all your answers in the Answer Booklet provided. Show all relevant steps to obtain maximum marks.
4. The required statistical book is provided.

Question 1

(a) A sample of 12 students is taken and their mean IQ calculated is 110 (with a sample variance of 220). What is the 95% and 99% confidence intervals for the population mean IQ based on this sample? What do you notice about the calculated interval as the confidence level increases? Do either of these two confidence intervals contain the known population mean IQ of 100?

[12 marks]

(b) Evaluate $\int_{-3}^{3}\int_{0}^{\sqrt{9-x^2}}\int_{0}^{9-x^2-y^2}\sqrt{x^2+y^2}\,dzdydx$ using **cylindrical coordinates.**

[13 marks]

Question 2

(a) Using the Fundamental Theorem of Line Integrals or otherwise, evaluate the line integral $\int_C \mathbf{F}\cdot d\mathbf{r}$ where $\mathbf{F}=xy^2\mathbf{i}+x^2y\mathbf{j}+e^z\mathbf{k}$ and C is the straight line from $(1,1,0)$ to $(2,3,0)$.

[6 marks]

(b) Verify Stokes' Theorem $\oint_C \mathbf{F}\cdot dr = \iint_\sigma (\nabla\times\mathbf{F})\cdot d\mathbf{S}$ where $\mathbf{F}=xy\mathbf{i}+x\mathbf{j}$ and σ is the portion of the upper hemisphere $z=\sqrt{4-x^2-y^2}$ above the horizontal plane $z = 1$, oriented upward.

[19 marks]

Continued...

Question 3

(a) Given that matrix $A=\begin{bmatrix}1 & 2 & 3\\ 0 & 4 & 5\\ 2 & 1 & 0\end{bmatrix}$.

(i) Find $\det(A)$. [4 marks]

(ii) Is matrix A invertible? Give your reason. [2 marks]

(iii) Suppose $B=E_1(2)A^T$, find $\det(B)$ where $E_1(2)$ is a 3×3 elementary matrix. [4 marks]

(b) Solve the following system of linear equations by using Cramer's rule.

$$\begin{aligned} 3x+2y-5z&=1\\ x+y-z&=2\\ 2x\quad\ \ +z&=8 \end{aligned}$$

[15 marks]

Continued...

Question 4

(a) Find the inverse of the following matrix using the partitioning technique:

$$\begin{pmatrix} 3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 2 & 0 & 0 \\ 0 & 5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 4 \\ 0 & 0 & 0 & 1 & 1 \end{pmatrix}$$

[6 marks]

(b) Solve the initial value problem

$$\begin{aligned} x_1'(t) &= -x_1(t) + x_2(t) \\ x_2'(t) &= x_1(t) + 2x_2(t) + x_3(t) \\ x_3'(t) &= 3x_2(t) - x_3(t) \end{aligned}$$

with $x_1(0) = 1$ and $x_2(0) = x_3(0) = 0$, the matrix $\begin{pmatrix} -1 & 1 & 0 \\ 1 & 2 & 1 \\ 0 & 3 & -1 \end{pmatrix}$ has eigenvalues -1, -2 and 3 corresponding to eigenvectors $\begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}$, $\begin{pmatrix} 1 \\ -1 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 1 \\ 4 \\ 3 \end{pmatrix}$ respectively.

[19 marks]

End of questions.